§ 13. Observation of L-H Transition in NBI Heated Plasmas at Low Toroidal Magnetic Field

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Improvement of global energy confinement time is an important issue for plasma confinement studies in LHD. It may be realized by formation of the transport barrier in the plasma edge and/or core region, similar to a tokamak plasma. In a limiter bounded plasma of CHS, of which configuration is very similar to LHD, the H-mode was realized in hydrogen plasma at the power almost same as the ITER scaling [1]. On the other hand, LHD has full helical divertor. From these points, it is worthwhile to study L-H transition in LHD. Recently, the L-H transition has been found in LHD at fairly low toroidal field Bt ≤ 0.75 T[2]

A typical high beta hydrogen plasma with L-H transition is shown in Fig.1(a), where B_t=0.75T and the magnetic axis position is R_{ax}=3.6 m. The relative change of the line-integrated electron density at various radial locations is shown in Fig.1(b). This figure clearly indicates the further broadening of the electron density profile. In some H-mode shots, edge electron temperature is also clearly enhanced (Fig.2).

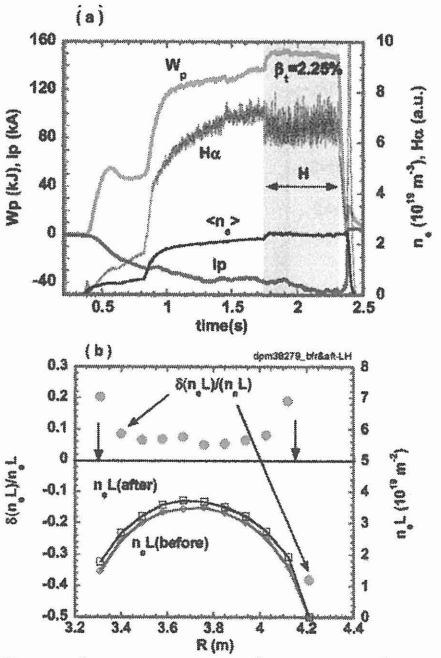

Fig.1 (a) Typical time traces of various plasma parameters in a typical H-mode discharge. (b) Radial profile of the relative change of line integrated electron density.

The absorbed NBI power achieved the L-H transition was compared with the ITER scaling translated to hydrogen plasma [3]. Although systematic power scan is not yet done, the threshold power seems to be about two times larger than the scaling. By the transition the particle confinement is improved by about 30%. The improvement of the global energy confinement time is fairly modest to be less than 10%, compared with ISS95-scaling. So far, an advantage of helical divertor on the confinement improvement by L-H transition is not recognized. Further study of L-H transition is required to clarify the physics mechanisms and to find more favorable path to H-mode with large confinement improvement.

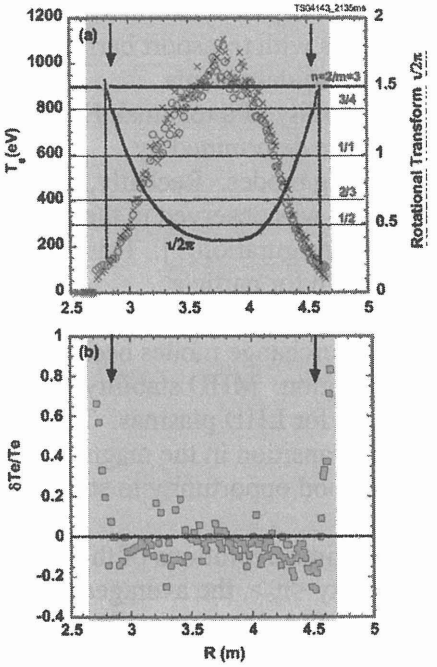

Fig.2 (a) Radial profile of electron temperature just before(crosses) and after(circles) the transition. Two arrows indicate LCFS of the vacuum field. Shaded zone indicates the expanded plasma region. (b) Radial profile of the relative increase in electron temperature across the transition.

References

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